26 00 00. ELECTRICAL
26 00 03. GENERAL PROVISION

.1 QUALIFICATIONS OF CABLE SPLICERS: Refer to Division 33.

.2 INFORMATION FOR DESIGN OF SYSTEM: During the initial planning conference, consult the University and Facilities Design and Construction, regarding the choice of primary service voltage to be used, its location, and the capacity available. Refer to Division 33 00 03.3.1 for requirements that the Architect/Engineer’s (A/E) Electrical Consultant shall follow.

.2.1 EQUIPMENT AND INSTALLATION GUIDELINES:

.2.1.1 an important aspect of Power System Design and Installation involves consideration of service reliability of the proposed system and loads that are to be supplied. System Installation inspection and Service reliability will be performed by the Contractor in the presence of the University Representative(s), Facilities Operations and Development, Electrical Utilities Shop when and if the Systems are to be connected to University Electrical Power Systems. The System shall not be energized if these requirements are not met or it fails Final Inspection.

.2.1.2 Contractor(s) and A/E’s electrical consultant(s) are responsible for addressing all the Design review comments to the satisfaction of the university in order to assure the continued reliability of the University Power Distribution System.

.2.2 SAFETY

.2.2.1 the incorrect application of Electricity and unsafe installation can cause both minor and serious accidents. The Designer must remain vigilant to Electrical hazards and take appropriate steps in meeting all safety rules and regulations in Electrical Power and Installation Distribution Design. It is important that the Design meet requirements of the following codes and regulations; NEC, NFPA, OSHA, and National Electrical Safety Code. It is also important that all the Equipment, Devices and Installations supplied and installed in all University’s Facilities meet high level of Safety Requirements, and the OSU Building Design Standards. It shall also be known that the equipment, devices, and installation that fail to meet these requirements will not be accepted.

.3 OVER CURRENT PROTECTION COORDINATION: For any building with an electrical service larger than 1,200 amperes, an analysis of the coordination of over current protection shall be shown on the drawings.

.3.1 the coordination study shall show the system by elementary diagram and indicate Arc Flash Coordination Study, Load Flow the available fault current at critical points in the distribution system and the selection of over current devices for time and interrupting capacity coordination. This study shall be part of design services in addition to the ones supplied by the electrical contractor.

.3.2 a copy of the final studies shall be approved by the A/E and uploaded following OSU’s Project Closeout Standards with the one line diagrams in electronic form.
.4 COORDINATION OF HARDWARE: All electric panel doors shall be equipped with BEST Access Systems cylinders with removable 7-pin cores. Refer to Division 08 for further details.

.5 Equipment belonging to other University Departments shall not be installed in or stored in Facilities Operations and Development mechanical or electrical rooms, unless permission is given by Facilities Operations and Development in writing.

.6 Building electrical power shall be from the OSU power system, when in the vicinity and available.

.7 PROHIBITED MATERIALS AND CONSTRUCTION PRACTICES:

.7.1 Door Closers: Refer to paragraph 08 70 20.5 regarding the prohibition against door closers with integral smoke detectors.

.7.2 Extra-flexible non-labeled conduit:

.7.3 Plastic conduit for interior electrical use, except that PVC conduit may be used for power circuits below basement concrete floors and for ground wires in any location. The transition from PVC to steel shall be made below the floor and shall be galvanized rigid steel conduit.

.7.4 Steel conduit shall not be used outside unless in concrete. Use aluminum conduit outside and wet locations above grade.

.7.5 Aluminum wiring shall not be used.

.7.5.1 Use of aluminum plated bus and aluminum wound transformers is prohibited in all OSU projects.

.7.6 Use of Incompatible Materials: Aluminum fittings and boxes shall not be used with steel conduit. All materials in a raceway system shall be compatible.

.7.7 Power actuated anchors or plug anchorage using wood, lead, or plastic.

.7.8 Multi-use Suspension Systems: Piggyback suspension systems for conduits, fixtures, etc. are prohibited. All suspensions must be hung independently from structure, or, in limited cases, from trapeze suspension systems.

.7.9 Use of wire ties to support conduit.

Exception: Flexible conduit for fixture whips may be supported with UV stable cable ties,

.7.10 Use of wood strips and wood screws to support lighting fixtures.

.7.11 Use of Class J fuses unless permitted otherwise in the Ohio State University Building Design Standards.

.7.12 Direct burial electrical cable at any voltage.

.7.13 Electrical ducts crossing above gas piping.

.7.14 Ducts within 10 feet of a buried steam line in any direction. If it becomes necessary to cross a steam line, acceptable insulation of the crossing must be approved by the Utilities High Voltage Services, Facilities Operations and Development.

.7.15 Hard insulated wire connectors, which have Bakelite or Ceramic insulation, are prohibited.
.7.16 Dimmable lighting unless permission is obtained in writing from the University Engineer. See 26 58 00.3.

.7.17 Armored cable (BX, AC, etc.)

Exception: MC Cable (Metallic cable with green ground wire) may be used where permitted in the OSU Building Design Standards

.7.18 Nonmetallic sheathed cable.

.7.19 Flat conductor cable type FCC, under carpet, etc.

.7.20 Fluorescent fixtures using other than 4-foot tubes are discouraged. Where 2’ x 2’ fixtures are needed, use 2’ long fluorescent tubes. Fluorescent U tubes are prohibited.

.7.21 Die cast setscrew and die cast compression type fittings.

.7.22 Locating the following equipment less than three feet from a wall: electrical equipment that permits or requires rear cooling, rear access for maintenance or cleaning, or rear connection.

.7.23 Bottom fed switches, breakers or fuses.

.7.24 Switches in which the blades pivot on the top.

.7.25 Switches, breakers, etc. that require greater than 75 pounds of force on the operating handle.

.7.26 Use of compact fluorescent lamps and/or T5 fluorescent lamps and fixtures as the main source of illumination in any area are prohibited unless approved by the University Engineer. Otherwise the use of compact fluorescent lamps or T5 fluorescent lamps shall be limited to accent lighting.

Commentary: The definition of “accent” is a wall or artwork not “a task or an egress path”. T5 Fluorescent lamps have no standard sockets; hence they cannot be purchased from the open market. It is not cost effective for maintenance.

.7.27 Use of cable tray with primary conductors.

.7.28 Time clock controls used on exterior or security lighting.

.7.29 Use of busway other than as permitted in Section 26 05 35.11.

.7.30 Use of bus way for panel risers.

.7.31 Tapping existing switchgear, switchboards, panelboards, and motor control centers to provide power for new feeders or equipment is prohibited in all University facilities.

.7.32 Troffers: Use of radiant ceiling panels.

.7.33 Lamps not manufactured by GE, Phillips, and Sylvania.

.7.34 Lamps provided by only one Manufacturer.

.7.35 Fixtures that require proprietary lamps.

.7.36 General Duty Safety Switches

.7.37 Custom Built Lighting Fixtures

.7.38 Recessed step lighting fixtures
.7.39 Exterior wall recessed mounted lighting fixtures
.7.40 Flush mounted in-ground fixtures
.7.41 Exposed wiring of any type in mechanical and/or electrical rooms
.7.42 Top entry in any exterior electrical equipment.

.8 SPECIAL REQUIREMENTS FOR MANHOLES OR VAULTS
.8.1 Manholes shall not be installed inside buildings.
.8.2 If there are existing manholes (MH) or vaults inside buildings undergoing major renovation that cannot be moved or relocated, then provision must be made for access by a live truck, known as the High Voltage Truck, for emergency pair, maintenance, and cable termination or replacement.

26 05 05. ELECTRICAL MATERIALS AND METHODS:

.1 UL LISTED EQUIPMENT AND MATERIALS: Specify only Underwriter's Laboratories listed equipment, assemblies, and materials when such items are available. The equipment and materials shall be installed in accordance with its listing.

26 05 15. WIRE AND CABLE

.1 MATERIAL: Copper conductors of 98 percent conductivity shall be used unless use is restricted by Government Agencies.

.2 SECONDARY CONDUCTORS:

.2.1 COLOR CODING
Color-coding for 480/277V and 208Y/120V shall be as follows:

<table>
<thead>
<tr>
<th>Phase</th>
<th>Voltage - 208Y/120</th>
<th>Voltage - 480Y/277</th>
</tr>
</thead>
<tbody>
<tr>
<td>Neutral</td>
<td>White/Gray</td>
<td>White or Gray (each with identifiable colored stripe)</td>
</tr>
</tbody>
</table>

A  Black    Yellow
B  Red      Orange
C  Blue     Brown

Equipment Green  Green w/ Yellow stripe
Ground

.2.2 Solid and Stranded Wire: No. 12 AWG and smaller may be solid. No. 10 and larger shall be stranded.

.2.3 Minimum size for lighting and power branch circuits: No. 12 AWG.

.2.3.1 Use No. 14 AWG stranded for control wiring between control panels and motor starters.

.2.4 Field wired incandescent fixtures shall be wired with Type SF 150-degrees C 300-volt wire.
.2.5 Field installed cords to portable equipment shall be type ST or G and Field installed cords for normal Equipment shall be type SRDT containing identified equipment.

.2.6 Circuit wiring through ballast channels of fluorescent fixtures shall be 600-volt 90-degrees C insulation. Fixture must be approved for through wiring, if thus used.

.2.7 General use insulation: NEC, 600-volt type THHN/THWN or XHHW.

.2.8 Connections in No. 10 and smaller wire shall be made with threaded-on plastic or nylon insulated wire nuts. Crimp connectors, except butt connectors, are prohibited. Joints in No. 8 and larger conductors shall be made with pressure type mechanical or split bolt connectors insulated with plastic electrical tape.

.2.9 MC cable may not be used in the following applications unless approved by the University Engineer:

Exposed conditions, in mechanical and electrical rooms, kitchens, science laboratories, utility spaces or medical facilities. MC shall also not be run exposed below eight feet above finish floor or as direct runs back to the panelboards.

Exception: MC Cable may be used as fixture whips for lighting fixtures provided MC cable longer than 6’ shall be properly supported.

Exception: MC cable may be used in existing walls

.2.10 MC Cable may be used for branch circuiting in offices, pool classrooms, and corridors of office and classroom buildings provided it is supported properly and run taut.

26 05 17. WIRING DEVICES

.1 DESIGN: All wiring devices provided shall be Heavy Duty specification grade. New building devices will be ivory with stainless steel plates for standard and ground fault interrupter use on normal power. Isolated ground devices shall be orange with stainless steel coverplates. Wiring devices on emergency power shall be red with stainless steel coverplates. In existing building, designers shall match existing color scheme that is prevalent throughout building with the exception of emergency power. All emergency power receptacles added to existing buildings shall be red.

.1.1 Placement of Receptacles:

.1.1.1 In standard size classrooms (49 students or less) provide a double duplex receptacle at the front of the classroom centered under the chalkboard. Provide two additional receptacles at the front of the room spaced half way between corners and double duplex receptacles. Back of rooms to be provided with single duplex receptacle at center of wall and two additional receptacles equally spaced from corners. Remaining walls to be provided with two duplex receptacles on each wall equally spaced.

.1.1.2 Classrooms (50 students +) Provide two duplex receptacles for the front wall, centered between the corners and double duplex receptacle at the center of the wall. Provide two duplex receptacles equally spaced on all remaining walls.

.1.1.3 Corridors shall be provided with duplex receptacles 35’ on center and a maximum of 15’ from end of corridor. These receptacles shall have separate circuits and shall not be fed from the adjacent room circuits.
.1.1.4 Lecture halls shall be provided with a double duplex receptacle centered on the front wall and two additional double duplex receptacles equally spaced between center double duplex and corners. Provide duplex receptacle in floor for podium. Provide additional receptacles throughout for cleaning. These receptacles shall be a maximum of 25’ on center. If lecture hall is provided with a lab bench, then provide bench with double duplex for every eight-foot of bench.

.1.1.5 Computer Labs shall be provided with at least two general-purpose receptacles equally spaced per wall in addition to all receptacles for computers. These general purpose receptacles shall not be wired with computer equipment.

.1.1.6 Mechanical room shall be provided with at least four duplex receptacles (one per wall) and additional duplex receptacle where walls are 25’ or longer.

.1.1.7 Offices: Provide a minimum of one duplex receptacle per wall.

.1.1.8 In utility tunnels receptacles shall be placed a maximum of 100’ on center and a maximum of 25’ from the entrance, exit or intersection of tunnel. These shall be GFCI type in NEMA 3R enclosures. These shall be located on the ceiling in line with the nearest light fixture.

.1.1.9 In pedestrian tunnels, receptacles shall be a maximum of 100’ on center and a maximum of 25’ from entrance and/or exit. Receptacles shall be GFCI type and mounted 48” above the finished floor to the top of the receptacle.

.1.2 Switches

.1.2.1 Switches provided for all uses shall be specification grade. Color scheme shall match receptacles.

.1.2.2 Switches provided at roof hatches or where provided outside of rooms they are serving shall be provided with pilot lights not lit handles.

.1.3 Coverplates

.1.3.1 Generally coverplates for flush-mounted standard devices shall be stainless steel for interior use in new buildings. Where work is being performed in existing buildings coverplates shall match the majority of the existing devices.

.1.3.2 Coverplates for exterior use shall be type, which allow NEMA 3R rating to remain while in use. Where exterior device could be exposed to vandalism, provide locking type coverplates.

26 05 19 MULTI-OUTLET STRIPS

.1 Multi-outlet strips for power or data and/or communications shall be two piece single channel steel capable of accepting full size heavy duty specification grade devices. It shall be provided with a standard ivory finish.

.1.1 Minimum dimensions of single channel multi-outlet strip shall be 1.26” X 2.75”.
DIVISION 26 – ELECTRICAL

.2 Multi-outlet strip for both power and data and/or communications shall be two piece channel multiple channel to keep power separated from data and/or communications wiring.

.2.1 Minimum dimensions of two channel multi-outlet strip shall be 1.75" X 4.75".

.3 Multi-outlet strips may be provided at laboratory benches, work benches and work counters in offices.

.3.1 Multi-outlet strips shall not be run through walls, fire rated or otherwise.

Commentary: Consider including duplex receptacles with USB ports where appropriate.

.3.2 Provide the University with 10% spare parts including but not limited to coverplates, elbows, entrance and end fittings, tees, utility boxes, etc.

26 05 29. HANGERS AND SUPPORTS

.1 MATERIALS FOR STRAPS AND HANGERS: Heavy-duty malleable iron or steel. For installation in locations above grade that are subject to moisture penetration, specify corrosion-resisting steel. Perforated straps are not acceptable.

.2 INDEPENDENT SUPPORT SYSTEMS: Required for all installations, except that light weight incandescent fixtures on, or recessed into, suspended ceilings may have adjustable bar strap supports carried on the ceiling suspension system.

.2.1 Surface outlet boxes, to which fixtures are attached, and pull boxes, shall be fastened to the structure independent of the conduit system supports.

.2.2 Conduits above suspended ceiling shall be attached to the structure and shall not be supported by a ceiling suspension system.

.3 COORDINATION WITH GENERAL CONSTRUCTION: The A/E shall include the following (or similar) statements in specifications for suspended lay-in ceilings:

.3.1 Surface mounted fluorescent lighting fixtures shall be supported from the structure above independent of any ceiling system by use of 3/8 inch all thread rods.

.3.2 Flush or recessed fixtures in ceilings of the suspended lay-in type shall be installed so that the long dimension of the fixture is supported on the main support member of the ceiling system. Provide at least two galvanized steel safety hangar wires or safety chains, attached from the fixture housing to the structure independent of the ceiling system. Wire or chain shall withstand a 3-foot, 50-pound drop test. In addition the Luminaire Support Requirements of NEC shall be strictly followed.

26 05 33.10 INTERIOR CONDUIT AND FITTINGS: Minimum conduit size for power circuits shall be 3/4-inch. Minimum conduit sized for control wiring shall be 1/2 inch.

.1 RIGID GALVANIZED THREADED UL LABELED CONDUIT shall be specified for use in exterior walls, outdoors, for indoors exposed (surface) applications from floor level to 8-feet above floor, seal penetrations, and all the areas having potential to corrode or eat away by chemical-action (corrosive atmosphere) and hazardous locations.

.1.1 Threaded couplings shall be used with rigid conduit and I.M.C.

.1.2 I.M.C. may be used in place of rigid galvanized where permitted by The NEC

.2 UL LABELED, GALVANIZED STEEL EMT may be used in interior partitions, above ceilings, and for surface applications, except in mechanical and electrical rooms and shop spaces where it may be used 8'-0" from the finished floor. In corrosive and hazardous locations, use fiberglass conduit.
.2.1 Insulating bushings and/or insulated throat fittings shall be used throughout EMT installations.

.2.2 Compression fittings shall be used exposed below eight feet from finished floors. Setscrew type fittings may be used in other applications.

   Exception: Setscrew fittings may be used below eight feet if bolts are not pointing outward.

.3 PLASTIC JACKETED RIGID STEEL CONDUIT shall be used in corrosive atmosphere.

.4 FLEXIBLE CONDUIT used for motor make up and lighting fixture connections. Minimum size: 1/2-inch for lighting fixture whips and ¾” for motor connections; maximum length: 6 feet 0 inches. Flexible conduit of any type shall not be used in interior partitions or in walls as a substitute for EMT, IMC or rigid steel conduit. A ground wire shall be pulled in all flexible conduit.

   .4.1 Plastic jacket shall be used on flexible conduit exposed to outdoor or moist locations.

   .4.2 Liquid-tight flexible metal conduit shall be used in raised floor computer room applications.

.5 RIGID ALUMINUM CONDUIT shall be used outdoors, above grade, in damp locations and may be used in other locations in place of rigid steel conduit where corrosion is not a problem.

.6 Conduit installed through a building wall shall have internal and external seals. Specify Linkseal or equivalent.

.7 Elbows used for medium voltage cable shall be long radius rigid steel or if above grade, outside, rigid aluminum.

.8 GROUNDING: Conduit crossing building expansion joints shall have expansion provision with grounding continuity.

26 05 33.11 BUSWAYS:

.1 The A/E shall not use Feeder Busways in lieu of conduit and wire except for short distances inside substation rooms. Maximum length shall be 10 feet.

.2 PLUG-IN BUS shall be used in shops where the load density provides an economic advantage over panels and shall not extend into more than one space. Plug-in bus shall be copper. Busway shall be used to serve one room or usable space. It is prohibited for busway to penetrate a fire rated wall. Provide two spare bus plugs of each size installed.

.3 INDOOR BUSWAY (if used) shall be water resistant per ANSI/IEEE Standard 141-1986.

.4 If use of busway is approved by special permission for a project, Contractor shall provide 50 feet of spare busway and 10% of total switches used. It includes when busway is installed in shop areas or specially approved conditions.

26 05 33.12 SURFACE RACEWAYS

.1 The A/E shall specify Surface Raceway / Metallic Raceway with associated coupling, boxes and fitting to be mounted to the surface of structure for the installation of Electrical Conductors. It shall be used in the following locations:

   .1.1 In dry locations.
.2 FITTINGS AND BOXES

.2.1 Raceway shall have manufacturer's finish standard prime coating suitable for field painting.

.2.2 Surface Metallic Raceway. Metallic surface raceway shall be one piece construction, manufactured of .040" steel with smooth finish manufacturer's standard color. Minimum size to be ¾" X 21/32".

.2.3 Surface Metallic Raceway shall be used in dry locations, extensions through walls, and shall be permitted to pass through drywall partitions and dry walls only if the length going or passing through is not broken. It is required that access to the conductors shall be maintained on both sides of the walls, partition and floor.

.2.3.1 The surface metallic raceway shall not be used where concealed, except as permitted by NEC. The use shall be limited to Class 2 power limited applications and communication.

26 05 33.13 UTILITY TUNNEL CONDUIT AND FITTINGS

.1 INSTALLATION REQUIREMENT for corrosive and external heat generating environment.

The conduit must be suitable for the best protection from corrosion in the most demanding environments such as utility tunnels, under bridges, chemical, utility plants, underground pipeline, laboratories, electrical substations, and parking lots.

The conduits and the fittings must meet the requirements of UL 1684 that covers conduit type AG for use above ground and/or below ground, and type BG for use below ground applications. The University requires that the Manufacturer supply a letter from UL, not a “Certificate of Compliance,” for the product to be approved for use in University facilities.

.1.1 The preferred conduit and fittings shall be fiberglass reinforced epoxy manufactured using the filament process. The optional conduit shall be PVC coated rigid conduit that provides maximum protection against corrosion where fiberglass conduit usage is extremely difficult.

.1.2 FIBERGLASS CONDUIT AND FITTINGS

The Fiberglass Conduit and Fittings Standards cover the application Installation, and use of associated Fittings. The primary intent is to incorporate changes in technology and incorporate products that were not Proven or existing when earlier versions of the University Building Design Standards were published.

All Fiberglass Conduits shall be listed by Underwriters Laboratory, UL Std., and UL 1684.

1.2.1 The materials made or manufactured for use as conduits, raceways, boxes, cabinets equipment enclosures, and the finished product (Fiber conduits) shall conform to the latest edition of NFPA 130, NFPA 502, NFPA 70(NAC) and shall have capability to withstand high temperatures up to 500 degrees C or (– 60 + 932 degrees F) for minimum of one hour. The Fiberglass conduits requirements of the Standards shall include the followings:

A. High Temperature Combustion Resistance
B. Low Smoke Zero Halogen.
C. High Mechanical Strength.
D. High Dimensional Stability.
E. High Chemical Resistance.
F. No impact from Stray currents.

1.2.2 The A/E shall make certain that the type of Fiberglass conduits specified are manufactured from epoxy resins that had flame resistance and low smoke characteristics, zero halogen and meeting the requirements of section 26 05 33 1.2-to-.1.2.1 of this Standard

1.2.3 The fiberglass conduit shall be available in diameters ¾” to 6” and shall be UL Listed for use above and underground.

Again, the resin system shall be epoxy based using a hydride curing agent. The permitted fiberglass shall possess continuous E-glass roving. All additives for increasing flame spread and lowering smoke density must be halogen free (i.e. must not contain chloride or bromine).

The permitted type shall use carbon black as ultra violet inhibitor to protect the conduit and fittings during storage and if or when it is exposed outside.

1.3 FITTINGS AND ACCESSORIES

All fittings, elbows, and accessories shall be manufactured from the same process, using the same methods and chemicals as the pipe. The exceptions are plastic duct plugs and access fittings (often referred to as nondalet fittings). Access fittings shall be made from fire retardant vinylester materials, halogen free, must be hot compression molded and shall have couplings attached to the body of the access fittings.

1.3.1 The use of Fiberglass conduit shall be permitted for both below and above ground if requirements of Section .1.2.2 of this Standard is met:

A. Tunnels
B. In Class 1 Division 2 Installation (For Class 1 and Div2 Application “XW” fiberglass Conduit shall be used meeting the requirements of section 501.10(B) of National Electric Code, and UL 1684A Listed for above Ground use)
C. Under Bridge Applications
D. Plenum Areas
E. Fire Pump Rooms
F. Elevator Shafts
G. High Temperature Applications.

1.3.2 Cement for PVC conduit and fittings shall be as recommended by the PVC class 1 div 2 conduit manufacturer

1.4 OPTIONAL PVC COATED RIGID METAL CONDUIT

1.4.1 The PVC coated conduit must be UL listed. The permitted PVC coating must have been tested and approved by UL as providing the primary corrosion protection for the rigid metal conduit.
DIVISION 26 – ELECTRICAL

.1.4.2 Applicable UL Standards may include: UL 6 Standard for safety, Rigid Metal Conduit, UL 514B Standard for Safety; Fittings for conduit and outlet boxes.

.1.4.3 The PVC coated galvanized rigid conduit must be ETL Verified to the Intertek ETL SEMKO High Temperature H2O PVC Coating Adhesion Test Procedure for 200 hours. The PVC coated galvanized rigid conduit must bear the ETL Verified PVC-001 label to signify compliance to the adhesion performance standard.

26 05 45. UNDERGROUND RACEWAYS:

.1 GENERAL REQUIREMENTS: All underground cables of any classification shall be installed in raceway systems. Raceways for street lighting shall be 2" minimum. All other applications shall be sized in accordance with the projected electrical load growth in the vicinity but not less than 1.5". For conduit requirements in utility tunnels and under bridges Refer to Division 33.

26 10 00. SECONDARY/LOW VOLTAGE ELECTRICAL DISTRIBUTION

.1 MAGNETIC INTERFERENCE AND MITIGATION

Magnetic Interference can pose major problems in the Design and Operation of Electrical and Electronic Equipment, Instruments, Control Systems, Data processing equipment and communication networks. This equipment frequently indicates aberrations whose sources may not be readily recognized, but which are due to magnetic interference. In general, such interference is classified as internal and external.

A. Internal Interference, created by Operation of Components within the system itself, can usually be eliminated or nullified by shielding the individual components and confirming the magnetic force they create.

B. External Interference is frequently caused by nearby or adjacent equipment such as transformers, medium voltage busway, or switching equipment, which generate magnetic “spikes” affecting apparatus which is not physically attached to the source of interference.

.1.1 Special Protective and Preventive materials: In addition to developing a basic protection design in preventing the penetration of magnetic interference, when it is required by this Standard to Design and specify EMF Mitigation Plans or Strategies that will prevent and solve the Magnetic Interference problems as described in Section 26 10 00.1. The expectation of this Standard is to reduce EMF to below one (1) milligauss, even in the most complex Field Environment.

.1.2 SPECIAL EMF SHIELDING MATERIAL: There are two means of EMF Shielding that may be used to achieve effective prevention of Magnetic Interference or Eliminate the existing problems (See Section 26 10 00.1.1 and 26 10 00.1.3).

In fields of low intensity, use CO-NETIC AA perfection sheet because of its high initial permeability and corresponding high attenuation characteristics. In fields with high intensity, use NETIC S3-6 sheet because of its high magnetic saturation characteristics. CO-NETIC AA Perfection Annealed Sheet are available in standard gauge .014" through .062" thick, in flat sheet sizes up to 30”x59” or Full Sheet of .015” thick and 36” by 120”.

2006 Edition, Published January 1, 2006; Division Revision Date: December 31, 2018
Installation: For wall or floor coverings, the designer shall specify that sheets shall be butted at seams, all seams flush and tight.

Fasteners: NETIC/CO-NETIC AA Sheets shall be mounted to walls by non-magnetic fasteners to penetrate the shielding sheets. Hole in the NETIC/CO-NETIC AA alloy sheets for fasteners shall be drilled with standard metal drills (Cobalt Steel Drill Bits). Special fastening application (masonry, concrete, etc.) shall be consistent with EMF shield manufacturer’s recommended attachment procedures and OSU Building Design Standards requirements.

Seams: All seams between sheets to be covered by CO-NETIC AA foil, 0.01 inches thick, by 4 inches wide, with factory supplied PST backing. Apply foil centered over the sheet seams and press down tightly.

Finishing: The CO-NETIC AA metal has a natural shiny, silver colored finish and will not rust. Gypsum Wallboard (drywall) or approved other materials shall be applied over the CO-NETIC AA sheets after seams are covered. No magnetic fasteners are to penetrate the CO-NETIC AA sheets.

.1.3 OPTIONAL SHIELD MATERIAL: The use of ferrous metal sheet for EMF shielding has been one method the University utilized for correcting EMF problems. But it has unavoidable installation difficulties for inexperienced installers. The sheet metal sheet is too heavy, requires accurate overlapping to achieve minimum EMF reduction, but it is very effective, if correctly installed.

Installation: All Medium voltage transformers and switch gear including motor control centers that are adjacent to or under offices, computer centers/rooms or locations that will have the use of Sensitive Electronic Equipment (SEE) shall be shielded with ferro-magnetic material.

Use of minimum 10 gauge ferrous steel sheet metal on the side(s) of walls where said offices or rooms are situated, to prevent moving charges that produce Electric Magnetic Field (EMF) penetration that in turn destroys or distorts sensitive electronic equipment.

In order to have an effective shielding, the 10 gauge sheet metal shielding shall be overlapped at a minimum of 4 inches at every joint.

.1.4 A/E’s electrical consultant(s) shall contact the University Engineer for details, if there should be any questions.

.2 TRANSFORMERS - UNDER 600 VOLTS

.2.1 General-purpose distributing transformers shall be single-phase and three-phase dry-type which are generally used with primaries connected to secondary distribution circuits. They shall be designed for the voltages of 120, 208, 240, 480, and 600 with ratings ranging from 500VA to 500KVA and frequency of 60Hz.

.2.2 The transformers shall be designed for continuous operation at the rated KVA for 24 hours a day, 365 days a year operation with a nominal life expectancy and greater overload capabilities in accordance with the latest ANSI-C57. The temperature rise of these transformers shall be 80 degrees C temperature rise and shall be insulated with a UL recognized 220 degree C insulation system. Transformers shall have k factor rating as recommended by ANSI/IEEE C57.110-1986, where required (i.e. computer center, lab, etc.). It shall have a 30 percent overload capability.

.2.3 The transformers shall be designed for a low coil watt loss.
.2.4 Coil and Core Assemblies

.2.4.1 Transformer cores shall be constructed with high grade, non-aging, grain-oriented silicon steel with high magnetic permeability, low hysteresis and eddy current losses.

.2.4.2 Transformer coils shall be wound of electrical grade copper and continuous wound construction. The neutral conductor shall be rated to carry 200% normal phase current, when required.

.2.4.3 Enclosure shall be ventilated, heavy gauge sheet steel primed and finished in gray baked enamel. The core and coil assembly of the transformers shall be impregnated with non-hygroscopic, thermosetting varnish and cure to minimize hot spots and seal out moisture. The core of the transformer shall be grounded to the enclosure.

.2.4.4 The sound levels of the transformer shall be designed in accordance with ANSI/NEMA recommended levels.

.2.4.5 Provide minimum clear working space of 3 ½ feet (3 ½’) about transformers operating at 600 volts, nominal, or less to permit ready and safe operation adjustment, repair and maintenance.

.2.5 Transformers greater than 25 KVA shall not be mounted on or near the wall adjacent to an office, computer room or laboratory unless the wall is magnetically shielded.

26 20 00. LOW-VOLTAGE ELECTRICAL TRANSMISSION

.1 EMERGENCY SERVICE: Refer to Section 26 30 10.

26 20 03. LOW-VOLTAGE SWITCHGEAR – SERVICE ENTRANCE

.1 PROTECTIVE DEVICES: Main breakers and feeder breakers or switches shall be equipped with ground fault protection as required by applicable codes. In critical applications provide coordinated ground fault protection on feeder breakers. Provide settings and coordination information with the service manuals.

.1.1: Where applicable the following warning sign shall be provided:

WARNING: SHUTTING OFF OF MAIN SWITCH DOES NOT SHUT-OFF POWER IN ENTIRE BUILDING.

Provide the following additional information as applicable:

A. ADDITIONAL MAIN SWITCH IS LOCATED IN ROOM O30M IN THIS BUILDING

B. AUTOMATIC TRANSFER SWITCH LOCATED IN ROOM 530M IN THIS BUILDING AND EMERGENCY GENERATOR IS LOCATED IN ROOM 036M OF MATH TOWER.

Include building and room number if emergency source is not in the same building as the main switch.

.1.2 All circuit breakers with solid state trip units shall comply with the following standards:

.1.2.1 ANSI/IEEE C37.90.1 – Surge Withstand Capability (SWC)
.1.2.2 ANSI/IEEE C37.90.2 – Withstand Capability of relay systems to Radiated Electromagnetic Interference from transceivers.

.2 The maximum operating force required to open or close a switch or breaker shall not be greater than 75 pounds on the operating handle.

.3 Vacuum breakers or vacuum switches may be used with the approval of the University Engineer’s Office.
   .3.1 All switches shall be top or horizontal fed to the breakers

.4 Indicator lamps shall be LED or transformer type utilizing low voltage lamps.

26 20 04. METERING: Refer to Division 33

26 20 05. SERVICE DISCONNECTS:
   .1 Secondary main disconnects shall be equipped with electronic trip devices.
   .1.1 The analysis diagram fault currents shall be shown on a symmetrical basis; and for calculation purposes, the transformer primary available fault supply shall be considered as unlimited.

.2 FUSES may be used in primary-voltage services, secondary-voltage main switchgear, distribution panelboards, and motor controls.
   .2.1 UL classification fuses shall be used as required for time delay and current limitation requirements of the application.
   .2.2 Class J fuse is prohibited with the exception of elevator power modules. Use class RK1, 200,000 AIC rated fuses for up to 600 amp applications and RK1 for maximum short circuit protection.
   .2.3 Fuses for secondary service mains and feeders over 600-ampere shall be UL Class L.
   .2.4 Spare Fuses: Specify that a spare fuse complement be stored on existing metal shelves, metal mounting boards, or in a cabinet in the electrical switchgear room and that a typewritten and framed bill of material is mounted nearby. If there is no existing storage or additional storage space is required, specify that Contractor provide a cabinet equal to Bussmann SFC and provide hardware to accept BEST 7 pin interchangeable lock cores.
   .2.4.1 Spare fuse complement shall include a minimum of three or 10% of the total each (whichever number is greater) spare fuses of each class, ampere, and voltage rating installed, including primary fuses and control circuit fuses in switchgear and any equipment.
   .2.4.2 Provide two fuse pullers for every size fuse and voltage rating.

26 20 06. GROUNDING SYSTEM:
   .1 DRAWINGS AND SPECIFICATIONS: Drawings shall show ground systems, protective conduit sizes, and relative locations. Specifications and drawings shall include detailed requirements of the grounding system. A reference only to the National Electrical Code, without elaboration, has proven to be insufficient. Specifying requirements only by referencing the National Electrical Code is prohibited. It is required that the A/E shall specify all requirements applicable, instead of referring only to National Electrical Code. All sensitive electronic equipment (computer rooms, etc.) shall have single point grounding system.
All connections to the grounding system shall be clamped, exothermic welded, cad weld or equivalent. It is required that the grounding system be tested and have a resistance reading of less than 3 ohms at the ground level. Only copper to copper may be clamped. The A/E shall calculate the system required to obtain 3 ohms. The contractor shall only be required to install the indicated system.

2 SERVICE GROUND: Grounding rods shall be a minimum size of 5/8” x 10’ copper clad steel and shall not be placed in back-fill. It shall meet current NEC requirements and other applicable codes.

.2.1 Interconnection of the service ground, system neutral, and equipment ground conductors shall be made within the service equipment.

.2.2 Grounding path through feeder conduits must be kept at less than five ohms resistance. The entire feeder conduit shall include a grounding conductor. The equipment enclosure (transformer case, etc.) shall not be used as a grounding path.

.2.3 Grounding conductors shall be 600-volt insulated installed in rigid PVC or rigid galvanized conduit. No metal parts such, as locknuts shall surround the ground conductor. If metal is used, protective conduits for ground conductors shall be bonded at both ends to reduce impedance in the ground path under fault current flow. All conduit connections shall be threaded and then welded.

.2.4 LIGHTNING PROTECTION: It is well documented that insulation levels of overhead lines is considerably higher than insulation levels of terminal apparatus including transformers, switchgears, pothead, etc. which make up or comprise the service entrance to buildings. Such overhead lines (University overhead lines at Airport, West & Midwest, and Regional Campuses) are vulnerable to over voltage, mostly from direct or indirect lightning voltages and switching surges. It is a fundamental characteristic of the traveling voltage waves to increase in voltage when they arrive at equipment having a surge impedance higher than that of incoming line and the magnitude of such incoming waves will approximately double at breaker. Therefore, this standard requires that all equipment connected by cable to overhead circuits shall have lightning/surge arrester protection at each end of the cable to guard against the possibility of transient over voltages. It is of great importance that protection against direct strokes is provided at outdoor substation installations in the form of grounded masts or overhead ground wires stretched above the installation to intercept lightning strokes, which might otherwise terminate on the lines or apparatus. It is also required that entrance equipment such as transformers, circuit breakers, etc be protected against direct stroke from traveling waves by installing lightning arresters that possess protective characteristics below the impulse insulation strength of the terminal apparatus.

.2.4.1 This standard requires that lightning/surge arresters be installed as close as possible to the HV/MV terminals of the Power Transformer and all other equipment requiring surge protection be grouped as close as possible to the arresters. Use the station type arrester for the best protective level and highest surge discharge ability for important and critical installations. But the intermediate class type arrester shall be used for less critical installations and mostly for feeder protection.

.2.4.3 This standard requires the following additional protective measures:

A. Grounding network resistance shall not exceed 5 Ohms (5Ω). Lower values are preferred.

B. Ground Conductors: The surge arrester grounding conductor shall be connected into the common ground bus. The grounding...
A conductor shall be run as directly as possible between the arresters and ground and be of low impedance and ample current carrying capacity. (See Section 26 20 06.2.4). These requirements must comply with National Electrical Code. (ANSI/NEMA 81-1990 (19, Article 190-193)).

C. Indoor locations: Arresters that are installed inside the buildings shall be enclosed or shall be located well away from passageways and combustible parts.

D. Installation: This standard requires that arresters must be located and installed in such a manner that the expulsion of gases or the arrester disconnect is not directed upon energized parts.

E. All protective lightning rods used for building or facility protection must have a Master Label pasted on them.

.2.4.4 A/E shall require electrical contractor to provide resistance testing. Testing shall be witnessed by the A/E and the university project manager. Test results shall be recorded on contractor’s letterhead and submitted as part off the Operation and Maintenance Manuals.

.3 TRANSFORMER GROUNDS:

.3.1 Building Service Transformers: Secondary neutrals shall be grounded separately from the neutral ground at the service main, unless close coupled in unit substation construction.

.3.2 Low Voltage Transformers: Secondary neutrals shall be grounded in the low-voltage service equipment, as required by NEC for services

.4 EQUIPMENT GROUNDS: A wire equipment ground shall be installed within the branch circuit conduit and be grounded to the cabinet of the panelboard to a non-insulated ground bus. The neutral bar of the panel shall not be used for equipment grounds.

.4.1 Equipment grounds and the identified neutral shall not be electrically interconnected on the building side of the service ground.

.5 CONVENIENCE OUTLETS: Specify that a wired ground be provided for continuity of ground path from the device-grounding pole. Provide ground fault interrupter outlets in wet conditions and where required by NEC and other related codes.

.6 EXTERIOR LIGHTING POLE: For steel-framed structure, explore a concrete-encased reinforcing bar electrode. A steel rod similar to the reinforcing bar shall be used to join, by welding, a main vertical reinforcing bar to an anchor bolt. The bolt shall be permanently connected to the base plate of the steel column supported on that footing. The Electrical System may then be connected for grounding to the building frame by welding or by a bronze bolt tapped into a structural member of that frame. For Electrical Systems grounding, specify that ground rod or ground copper wire is provided for equipment grounding at each light fixture. All underground PVC conduits to the light poles shall contain a dedicated ground copper wire in combination with equipment grounding. It shall be designed to provide a safe method of protecting electric distribution systems by causing the overcurrent or ground fault protective equipment to disconnect the circuit in case of ground fault.
26 27 03. DISTRIBUTION:

.1 DESIGN: If feasible, the secondary main breaker shall be made a part of the building distribution switchgear or switchboard. In no case shall the switchgear or switchboard or panelboard be directly attached to the transformer. A minimum 12-inch space with solid barrier is required to reduce the transfer of transformer heat to the low voltage section. Reduction of heat transfer may be accomplished with secondary throat or ventilated transition section.

.1.1 All dual fed switchgear with a tiebreaker shall have trapped key interlocks per ANSI/ASSE Z244.1-2003 to prevent paralleling two electrical sources. The testing, phasing, and startup of dual fed switchgear shall be under the supervision of OSEP Utilities High Voltage Services.

.2 EQUIPMENT: Metal-Enclosed switchgear or distribution boards shall be used in buildings or University Facilities at 600V and below for Service Entrance Power, lighting distribution and as the secondary sections of Unit Substations. The following components shall be specified as required:

A. Service Protectors
B. Model-Case circuit breakers, group, or individual mounted.
C. Fusible switches
D. Motor Starters
E. Low Voltage AC Power circuit breaker (generally limited to main or tie position)
F. Bolted contact pressure switches
G. Transfer devices or switches
H. Instrumentation, metering and relaying

.2.1 Type of Molded Case Circuit Breakers: These devices are available in the following general types: Thermal-Magnetic Dash Pot, Magnetic only, Integ rally Fused, Current Limiting, and High Interrupting Capacity. It is required that all circuit breakers that are equipped with solid state trip unit must comply with Section 26 20 03.1 of this Standard.

.2.1.1 Air circuit breakers shall be draw out type, installed in individual compartments.

A. Interrupting ratings of air circuit breakers and molded case breakers shall not be applied in "cascade".

.2.2 The handle operating force on all equipment shall be 75 pounds or less.

.3 PROVISIONS FOR ADDITIONAL CIRCUITS:

.3.1 Size of Switchgear or switchboard: Select a size that will provide sufficient spare spaces, complete with bus and hardware, for a reasonable forecast of future installation of circuits. A minimum of one fully bussed spare section shall be provided. Provide the following spare devices at the design stage:

For Fusible Switchboards
four 30 amp/3 poles
four 60 amp/3 poles

For Circuit Breaker Switchboards
ten 100 amp/3pole*
one 225 amp 3/pole*
two 100 amp / 3 poles
one 200 amp / 3 poles
*with adjustable trips

.3.2 Additional Section: Provide space and the bus arrangement for the addition of future switchgear or switchboard sections.

.4 INSTRUMENTATION shall be per section 26 20 04. Metering.

.5 SERVICE TO FIRE PUMPS: Fire pumps shall be served and protected as required in NFPA No. 20.

.6 Use switchboard instead of panelboard for emergency systems for the purpose of future growth and expansion. The switchboard shall be equipped with metering systems as required in Division 33 of this Standard.

.7 When adding switches, circuit breakers, bus plugs or motor starters to existing equipment, the A/E shall include the following on his/her design documents:

.7.1 The manufacturers’ nameplate data including manufacturer, catalog information and order number of the existing equipment.

.7.2 If the equipment is no longer being manufactured (i.e., Continental, Arrow Hart, Crouse Hinds, etc.) the A/E will contact a company that specializes in obsolete equipment and obtain information about availability of equipment and mounting for the bidding of the project.

.7.3 The A/E will provide appropriate staff and equipment during the design phase to open equipment to verify equipment has bussing, capacity and actual space to allow addition of switches, circuit breakers and/or starters.

26 27 04. FEEDER CIRCUITS:

.1 SYSTEM DESIGN: Design feeders for a voltage drop of not more than 2 percent between terminals and capacity for 30 percent load growth above initial design, unless greater growth is designated by the University in the initial planning conference.

.2 FEEDERS: Feeder ratings shall not be such a large percentage of the main that coordination of time and current and interrupting capacities cannot be achieved.

.3 WIRING: Specify that all feeders be installed in full-weight rigid conduit.

26 27 05. GENERAL PURPOSE POWER AND LIGHTING CIRCUITS: Voltage drop in branch circuits must be considered in design. Increase conductors a minimum of one size when 120 volt branch circuit home runs exceed 75-feet.

.1 LIGHTING CIRCUITS shall not be loaded to exceed 70 percent of panel breaker rating.

.2 SERVICE CIRCUITS: Not more than six unassigned general use duplex convenience outlets shall be on any one 20-ampere branch circuit, which includes prewired furniture, and lecture hall tables.

.2.1 Corridor receptacles shall not be connected to any adjacent room receptacles.

.3 BRANCH CIRCUIT PANELS: Panels for lighting, convenience outlets, small motors, and equipment shall be molded case circuit breaker type with thermal-magnetic trip and a-c and d-c ratings. Minimum number of poles in any panel enclosure shall be 42. Maximum
number of poles shall not exceed 84. Provide spare circuits and spaces as noted in paragraph .3.3.1 below.

.3.1 Breakers shall be 20-ampere, 1-pole breakers, mounted in the panel with bolted bus connections.

.3.1.1 Trip rating of breakers for lighting and general use convenience outlets shall be 20-ampere. Provide other sizes as required for special loads.

.3.2 Sub-Feed Breakers: Panels shall not have sub-feed breakers. If two panels are supplied from a long feeder, use sub-feed lugs or separate splice box with full size tap to panel mains. (no panel feeder shall feed more than 84 poles)

.3.3 When installing new branch circuit lighting panels on a project the following shall be considered:

.3.3.1 All new panel enclosures shall be 42 pole minimum. Designers shall provide each new panel with a minimum of 15% spare 20 amp single pole circuit breakers and 15% spaces. Designers shall consider an additional panel when these minimums cannot be met. **Phases shall be balanced as close as possible.**

.3.3.1.1 Life Safety panels may be 12, 18, 24 or 30 pole where amount of load on panel is minimal.

**Commentary:** An example is for poles 31 through 41 (odd) to be 20 amp, 1 pole spares and poles 32 through 42 to be spaces.

.3.3.2 New panels shall be 200 Amp minimum for 208Y/120 volt, 3 phase, 4 wire service and 100 Amp minimum for 480/277 volt, 3 phase, 4 wire service. Do not provide 240/120 volt, 3 phase, and 4 wire tapped delta systems. Where 240 volts, 1 phase is needed, Use buck/boost transformers as required.

.3.3.2.1 Life Safety panels will be permitted to be a 100 amps or less depending on project requirements

.3.3.3 Any new or existing building with three-phase service shall only have three phase panels provided. All exceptions must be approved by the University Engineer.

.3.3.4 Do not provide panel feeders, fusing, or main circuit breakers at less than the panel main bussing rating.

.3.3.5 Branch circuits shall not be provided with shared neutrals regardless of what is existing in the facility.

.3.3.6 Where multiple branch circuits pass through a single box, all circuit breaker handles shall be provided with common tie, so all circuits will be taken out of service for servicing of the circuits.

.4 **POWER PANELS** shall be equipped with molded-case circuit breakers of adequate interrupting capacity, or shall be switch and fuse construction using time-delay fuses.

.5 Provide a dedicated 15 or 20 amp, 120 volt, single phase circuit for each hand dryer shown on the drawings.

.5.1 Provide GFCI circuit breakers where required.

---

**26 29 00. LOW VOLTAGE CONTROLLERS**

2006 Edition, Published January 1, 2006; Division Revision Date: December 31, 2018
26 29 03. MOTORS AND MOTOR CONTROLS:

.1 RELATED WORK: Air-conditioning chiller starters and fire pump controllers shall be specified with the equipment in Divisions 23 and 21. Wiring from switchgear or switchboard to this equipment shall be specified in Division 26.

.2 NEMA AND NEC REQUIREMENTS:

.2.1 MOTORS AND MOTOR CONTROL EQUIPMENT shall conform to NEMA voltage ratings.

.2.2 MOTOR BRANCH CIRCUIT PROTECTIVE DEVICES shall meet the requirements of NEC 430.

.3 MOTOR CONTROL CENTERS: Class I, Type C with terminal strip terminations.

.3.1 LOCATIONS: Centers shall not be located where ambient temperature could cause de-rating of overload devices.

.3.2 OVERLOAD HEATER CHARTS shall be furnished mounted inside doors of cabinets or separately framed and mounted outside the equipment.

.4 REDUCED VOLTAGE STARTERS: Motors, sizes shall be such that the inrush current exceeds 40 percent of the building transformer rating. Motors shall be equipped with reduced voltage starters of the closed transition auto transformer or star-delta type, or solid state soft start, or current ramp starters.

.5 OPERATING PROTECTION:

.5.1 CERTIFICATION by the motor manufacturer that motors meet the voltage requirements of NEMA.

.5.2 OVERLOAD RELAYS: Poly-phase motor controls shall be equipped with three overload relays. Reduced voltage starters shall provide overload protection during the starting step.

26 29 05. MOTOR STARTER APPLICATIONS:

.1 TYPE OF STARTERS: Alternating current (AC) magnetic-fused-type starters, NEMA Class E2 in accordance with ANSI/NEMAICS2-1983(26) shall use current limiting power fuses and magnetic air break contactors. Each starter shall be completely self-contained, pre-wired, and with all components in place. Air break contactors if employed shall be current rated based on motor horsepower requirements. It is important to know as a guideline that combination starters will provide an interrupting fault capacity of 260MVA symmetrical on a 2300V System, and 520MVA symmetrical on a 4160 or 480V System. This starter must comply with ANSI/NEMA ICS2-1983 (26), Class E-2 controllers NEC 2005-760 and applicable IEEE and current ANSI Standards.

.1.1 Starters for 600V and below, the design must conform to ANSI/NEMA ICS2-1983(26). This is a requirement for magnetic controller ratings of 115-575V. AC Motor starters and contactors may be used for controlling the circuit to the motor. This standard requires that starters should be carefully applied on circuits and in combination with joint short-circuit protective devices such as circuit breakers, fusible disconnects that will limit the available fault current and let through energy level that starter can safely withstand. This withstand must meet the requirements of ANSI/UL 508/1983(29), and ANSI/NEMA ICSI-1983(25), (26) which cover controls, systems, and devices.
.1.2 The starters shall not be used without an adjacent line-switch. A non-fused disconnect switch shall be installed; and shall be located as close to each motor as much as possible. This standard forbids the installation of a remote switch with lock arrangement, at switchgear, switchboard. Panel board or a unit in a Motor Control Center.

.1.3 All rooftop mounted equipment shall be provided with a local disconnect switch.

26 30 00. FACILITY ELECTRICAL POWER GENERATING AND STORAGE EQUIPMENT

26 30 10. EMERGENCY POWER SYSTEMS:

.1 ALTERNATE POWER SOURCES: The University Master Plan provided for connecting groups of buildings with parallel power circuits for obtaining electric power supply to a building from alternate sources. Where the interruption of electric power supply to a building would result in hazard to life or property, major loss of research or equipment, provision shall be made for an emergency supply of power, to be used in the event of failure of the normal supply. Details of the plans as they apply to the project shall be explained and included in the early Design/Development submittal and conferences. If tie-in on existing circuit or feeder is not practical at present, provision shall be made for future tie-in. Emergency Power Systems are of two basic types:

A. An Electric Power Source set apart from the Prime Source of Power Operating in parallel that maintains power to the critical loads should the Prime Source fail.

B. An available reliable Power Source to which critical loads are rapidly switched automatically when The Prime Source of Power fails. (AC Source)

.1.1 References

A. NFPA 110 Emergency and Standby Power Systems

.1.2 Automatic Transfer Equipment: Reliable equipment and transfer switch must be specified.

.1.3 When emergency generators are specified, the A/E shall specify to include requirements for demonstrated load tests by a factory representative.

.1.4 Provide identification labels showing normal, emergency, and connected load sources along with building name and room numbers for any automatic transfer switches.

Commentary: Identification labels shall provide the following information:

A. Normal Service – source, building (if different then building in which automatic transfer switch is located) and room number Label shall be black with white lettering.

B. Emergency service - source, building (if different then building in which automatic transfer switch is located) and room number. Label shall be red with white lettering.

C. Emergency load - source, building (if different then building in which automatic transfer switch is located) and room number Label shall be red with white lettering.

.2 Emergency and Standby Systems: It is required that provision be made by designing an emergency power system / standby power source supplied by:

A. Engine Generator
B. Separate Emergency Source

Commentary:

Emergency power systems are defined as systems which are intended to automatically supply illumination, power or both, to designated areas and equipment in the event of failure of the normal supply or in the event of an accident to elements of a system intended to supply, distribute and control of illumination essential for the safety to human life.

Standby Power systems is defined as providing power to loads that upon loss of power during any interruption of the normal electrical supply could create hazards or hamper rescue or fire-fighting operations.

2.1 Emergency electrical systems shall provide power to but not limited to the following essential electrical functions:

1. Life safety Illumination
2. Fire detection and alarm systems
3. Elevators
4. Fire Pumps
5. Public Safety communications systems
6. Essential Ventilating and smoke removal systems
7. Processes where current interruption would produce serious life safety or health hazards
8. Maintaining Business Continuity

2.2 Standby electrical systems shall provide power to but not limited to the following functions:

1. Heating and Refrigeration systems
2. Communications systems
3. Sewage Disposal
4. Lighting
5. Industrial processes
6. Generators provided for dedicated lab equipment

2.3 Circuit breakers provided with generators shall be provided with lock out tag out capabilities.

2.4 Emergency generator drives shall be evaluated on a project by project basis.

2.5 The NFPA 110-5.6.6 required generator remote annunciator monitoring panel by shall be located next to the fire alarm remote annunciator panel.

2.6 Emergency generator fuel type shall be reviewed and evaluated with FOD Utilities Department and approved by the University Engineer.

Commentary: Diesel is considered to be the primary fuel type for emergency generators. Natural Gas may be considered, but the impact of limited fuel source and business continuity shall be evaluated.

2.6.1 Location of the generator shall be reviewed with the University Engineer, University Architect and University Landscape Architect to determine the best location. The University’s preference is for the generator(s) to be placed at grade level.

Commentary: Points to consider include but are not be limited to the following:

A. Flood Plain
B. Esthetics
C. Grade Level
D. Maintainability

.2.6.2 If the generator cannot be located at grade level the following provisions shall be provided:

A. A path from the generator shall be provided with conduit(s) and conductors to allow for connection to a future temporary generator. Provide a quick connect generator switchboard with quick connect cables of sufficient conductor length so that no additional conductors shall need to be provided.

B. Provide three 120 volt 20 amp circuits from an emergency source adjacent to the quick connect generator switchboard should a temporary generator need to be provided.
   1. One circuit shall be for a temporary battery charger
   2. One circuit shall be for a temporary block heater
   3. One circuit shall be for engine status.

C. An internal load bank shall be provided for all buildings where generators are not located at grade level.

D. A path and any required equipment (i.e. pumps, above ground tank, appropriate piping, etc.) for the filling of fuel for sub base or day tanks shall be provided when the diesel generator is not located at grade level.

E. Provide an automatic shutoff for the fuel line if fire is sensed at the tank.

.2.7 A/E shall only specify above ground, sub base or day tanks for fuel storage. Underground tanks are prohibited. A spill control kit shall be provided near any tank, See 2.5.5 for details.

.2.7.1 Storage tank fill pipe shall have a cap that shall accept a padlock. (Padlock shall be furnished by the University)

.2.7.2 Above ground tanks placed outdoors shall be placed inside secured screened areas. Location of tanks shall be approved by the University Architect and University Landscape Architect in consultation with the University Engineer.

.2.7.3: The above ground tanks shall be either of the following:
   A. Double walled construction or
   B. Located in a secondary containment curb that can contain entire (110% if outdoors) tank contents.

.2.7.4 The A/E shall ensure that the University Project manager is provided with information relative to any fuel storage tank and the tank installation. University project manager shall share this information with OSU-Environmental, Health and Safety group.
.2.7.5 Spill control kits shall be stored in a 20 gallon yellow drum and contain the following items as a minimum:

- One (1) Gallon of Super absorbent (ENSORB(R) or equal)
- Six (6) 42” socks
- Fifty (50) 15” x 20” absorbent pads
- Two (2) pairs of Nitrile Gloves
- Two (2) pairs of Goggles
- Two (2) 18” X 30” disposable bags and ties
- One (1) emergency response guide
- One (1) Instruction Sheet and Safety Data Sheets

.2.8. Contract Documents shall include the following in addition to any other requirements of the code.

A. Proper distances shall be provided from buildings, property lines, pedestrian traffic, building air intakes, and storm outlets.
B. Spill control shall be included via either double wall or secondary containment.
C. Above grade tanks shall be installed inside a secure screened area that is lockable and approved by the university Architect.
D. Provide permanently placed bollards for vehicular barrier protection.
E. An overfill prevention mechanism alarm monitoring system shall be provided
F. Provide a spill container to capture overfill at the fill connection locations.
G. Storage tanks shall be grounded
H. Feed lines shall be engineered to be protected from rupture and corrosion.

.2.9 Generators shall not be cooled using “Potable water”.

.2.10 Generator battery chargers and block heaters shall be connected to an emergency power panel.

.2.11 Emergency lighting shall be included at the generator location, in all mechanical equipment spaces, and in electric transformer and switchgear or switchboard spaces. Substation lighting and receptacles shall be included on the emergency system.

.2.12 Electrical Equipment fed from an emergency generator or any two sources shall be tagged with a red label and white lettering.

A distinctive warning sign shall be provided indicating the location of both sources of power.

Commentary: Signage at an automatic transfer switch may be similar to the following:
NORMAL SERVICE – MAIN SWITCHBOARD MSB IN LOCATED ROOM 7M IN THIS BUILDING

EMERGENCY SERVICE - EMERGENCY SWITCHBOARD ESB LOCATED IN ROOM 35M IN THIS BUILDING

EMERGENCY LOAD LOCATED IN ROOM 10M IN MATH TOWER.

2.13 Generator batteries

A. Batteries shall be maintenance free heavy duty type.

B. Lead acid storage battery set of heavy duty diesel starting type.

C. Battery set shall be compatible with the starting system and voltage.

D. Provide sufficient capacity for 1.5 minutes of total cranking time without recharging being required.

E. Provide the following items as required:

   .1 Battery rack, cables, clamps and removable cover

   .2 Battery heater pads

2.14 Battery Chargers

A. Battery chargers shall be current limiting type and shall recharge the batteries automatically.

B. The battery charger shall float at 2.17 volts per cell and equalize at 2.33 volts per cell.

C. Chargers shall be provided with overload protection, silicon diode-full wave rectifiers, voltage surge suppression, DC ammeter and fused AC input.

D. AC input voltage shall be 120 or 277 volts pending on the source available +10%.

E. Amperage output shall be no less than 10 amperes

F. Charger shall be provided with charger/battery failure alarm and dry contacts output to generator controller.

2.15 Environmental Considerations

2.15.1 The engine shall be EPA-certified with an accessible and readable nameplate. Provide complete documentation that the engine meets all US EPA requirements. A copy of this documentation needs to be provided to the project manager for transmittal to OSU-EHS.

2.15.2 Provide specifications for the emergency generator to the university project manager to furnish to OSU-EHS. OSU-EHS will obtain the necessary permit-by-rule (PBR) for the generator from the Ohio EPA.

2.15.3 Show location and specifications for the exhaust from the emergency generator. OSU has specific Building Design Standards relating to rooftop exhaust stacks. See Appendix V

2.15.4 Batteries shall be located such that any potential leakage is contained and any supporting structure/concrete will not be damaged.

2.16 A/E shall include commissioning elements in the project manual.

2.17 On site load testing of emergency generators

2.17.1 Provide a minimum of two hour on site load test after generator is installed.
.2.17.2 The generator will be tested the first half hour at 50% load.

.2.17.3 The second half hour shall be tested at 75% load.

.2.17.4 The final hour of testing will be at 100%.

**Commentary:** The load test may be expanded to four hours at the A/E’s discretion.

.3 AN EMERGENCY PANELBOARD shall be provided for:

.3.1 Exit lights.

.3.2 Minimal hallway and stairway lighting and telephone power.

.3.3 Fire alarms, building security equipment, and fire protection systems; this does not eliminate the need for batteries. Batteries shall be tested to indicate amp-hour availability. The Manufacturer shall provide documentation that indicates conformance with repaired rating to the University.

.3.4 Elevators and/or elevator rooms when required by OBC.

.3.5 Traffic signals fed from the building.

.3.6 EMERGENCY ILLUMINATION: Emergency illumination shall be part of emergency lighting that shall include illuminating all required means of egress lighting, illuminated Exit Signs, Stairwell Lights, and all locations where emergency lighting must provide at least code required minimum illumination to allow easy and safe egress from the area involved.

.4 WIRING FOR EMERGENCY SYSTEMS shall be in separate conduits. Specify that all emergency system junction boxes and covers shall be painted red.

.4.1 Switches for emergency lighting circuits shall not be accessible to the public.

.5 TRANSFER SWITCH: Transfer switch is a vital part of the proper operation of the system. In addition to current carrying abilities, transfer switch must be able to withstand voltage surges to meet reliability requirements. Special consideration over normal circuit devices or breakers should be given to transfer switch because of its application requirements. Its design must include normal duty, and fault current ratings of the switch. These play an important part of transfer switch application and protection scheme. It shall be capable of closing into high currents, of fault currents without damage, and withstanding severe duty cycle in switching normal-rated load. The design and operation of transfer switch must meet the requirements of this Standard and the following Codes and Standards: NSI/NFPA 70-1987(12) (National Electrical Code (NEC), NFPA 99-2002 and NEC 700-2005.

.5.1 In addition to the two sources feeding the automatic transfer switch, provisions shall be provided so that equipment, on the load side of automatic transfer switch, can be locked-out-tagged-out.

.5.2 All new and existing buildings being provided with generators shall be provided with automatic transfer switches to separate emergency and standby systems.

.5.3 Existing buildings where emergency and standby systems are not on separate transfer switches shall provide new transfer switches to accommodate new emergency and/or standby loads being provided by the project.

.6 EXISTING GENERATORS

**Commentary:** Each existing generator will need to be looked at on a project by project basis. Many of the existing university generators are currently at rated load or over rated load. And will not be able to accommodate any new loads.
.6.1 Existing capacities will need to be reviewed with the University to determine if the generator can serve any new loads.

.6.2 No new loads may be added to an existing generator without written permission from the University engineer or their designated person.

26 37 00. ELECTRICAL PROVISION FOR ELEVATORS

.1 WIRING AND SWITCHING: Wiring shall be extended to fused switches located in elevator room.

.2 EMERGENCY CIRCUITS: An emergency circuit to mid point of the hoist way shall be provided for the elevator cab light, fan, and equipment room.

.3 PIT INSTALLATIONS: Refer to Division 14. A light, light switch and GFCI convenience outlet must be provided in the pit of each elevator, each on separate circuits. If a sump pump is required for the elevator pit, then the sump pump will be provided with a dedicated circuit feed and not tied into the lighting or GFI circuit.

26 40 00. ELECTRICAL AND CATHODIC PROTECTION

26 41 00. FACILITY LIGHTNING PROTECTION:

.1 Each building shall be considered individually to determine the necessity for lightning protection. Lightning Risk Assessment calculations as noted in NFPA 780 Annex L shall be performed and submitted to the University through the project manager for review.

.1.1 If it is deemed necessary to provide the lightning protection system for the facility, then the A/E shall design and specify an Underwriter's Laboratory Master Label System.

.1.2 If it is decided that lightning protection is not necessary, this decision should be made a matter of record. A listing of the people consulted shall be included in the conference memos along with "RISK" calculations noted above.

.2 GROUNDING SYSTEM REQUIREMENT: Because of possibility that a breakdown in grounding insulation may accidentally energize all plant or facilities, this Standard requires that ground connections shall be made to the electrode by methods providing the required permanence and ampacity, such as:

.2.1 A permanently effective clamp, fitting, brace, or weld.

.2.2 A bronze plug, which has been tightly screwed into the electrode.

.2.3 All non-current carrying metallic structures or steel frame building are grounded.

The main purpose of grounding system is as follows:

.1 To maintain low potential difference between metallic parts, ensuring freedom from electric shocks to personnel in the area.

.2 To avoid fires from volatile materials and ignition in combustible atmospheres by providing an effective electric conductor system for the flow of ground fault currents and lightning (See Lightning Protection in Section 26 20 06.2.2.4 of the Standard). The connection between the grounding electrode and the earth should have a resistance less than 5 ohms.

.3 All existing lightning protection system shall be maintained during building renovations and extended to any additions to the building.

.4 Any new and existing systems will have UL Master Label “C”. 
.5 Copy of UL Master Label C certificates shall be given to the University Engineer.

.6 Original certificate shall be framed and located next to fire alarm panel.

.7 Copies of certificate shall also be included in Operations and Maintenance Manuals.

26 42 00. CATHODIC PROTECTION

.1 UNDERGROUND PIPING: Refer to 22 70 30. (15490) for cathodic protection method when such protection is determined to be appropriate.

26 50 00. LIGHTING

.1 LIGHT LEVELS-GENERAL: All new lighting installations at The University shall comply with the Code for Energy Conservation in New Building Construction. (Ohio Building Code, Article 27, O.A.C. 4101:2-27). Lighting requirements for the most common University building areas are set forth in this standard. The referenced light levels are understood to be a maintained light level. Light levels are measured at a 30-inch height from the floor or at the actual work surface, and represent the average level for the area or workstation. Circulation areas beyond workstations should be lighted to one-third the light level of the workstation, but in no case less than 20-foot candles.

.1.1 Specify that contractors shall fuse all indoor and outdoor lighting fixtures when installed.

.1.2 Utility Tunnels: Provide 2 foot-candles minimum with fixtures spaced 20’ to 25’ apart down the center of the tunnel on the ceiling. Provide vapor tight ceiling mounted fixtures using compact fluorescent lamps with appropriate globes and wire guard. Use fiberglass conduit with PVC boxes for tunnel lighting.

26 51 00. INTERIOR LIGHTING

.1 RECOMMENDED FIXTURES: Fluorescent fixtures using 4 foot T8 tubes are generally preferred. Incandescent lighting may be used only with the written permission of the University Engineer. Any department requesting approval of incandescent lighting must be willing to accept financial responsibility for the maintenance of the incandescent lighting. Where incandescent lamps are used as part of an equipment system or alarm, provide a minimum of 12 or 10% (whichever is greater) spare lamps of each wattage.

.1.1 The use of High Pressure Sodium (HPS) Lamps in fixtures for lighting large or open areas is recommended by this Standard in combination with metal-halide lamps for greater energy saving. Almost without exemption, the High Pressure Sodium (HPS) lamps shall be the choice for greatest economy and least use of energy, but the use shall be limited to warehouse large areas and high ceilings.

.1.2 Mercury vapor lights are not to be used. Exceptions, for research applications, must be submitted by the A/E for reviewed and approved by the University Engineer.

**Commentary:** mercury vapor lamps are no longer in production.

.1.3 METAL HALIDE lamps shall only be used in areas where there is assurance that they will be turned off at least once a week; this reduces the possibility of an explosion at end of life. Their use should be limited to areas in which network television coverage is expected, accurate color rendering is required, or gymnasiums.
.1.4 FLUORESCENT FIXTURES: All fixtures shall be independently supported from the structure above. Fixtures shall be all metal with hinged shielding louvers. Recessed fixtures with hinged frame open louvers may be used where required for architectural effect. Two hundred seventy-seven (277) volt fixtures shall be used where this voltage is available. Fixtures shall meet or exceed the requirements of the Code for Energy Conservation in New Building Construction.

.1.5 QUARTZ LAMP FIXTURES are not recommended; if used they must have lenses to protect against exploding lamps.

.1.6 Ballasts: High Frequency Electronic type, specifically designed to use T8 lamps, instant start, to operate multiple lamps in a parallel configuration. Ballasts shall meet minimum performance standards as established by the Certified Ballast Manufacturers Association. Additional requirements shall include a maximum Total Harmonic Distortion of 20 percent, sound rating of "A", shall comply with applicable standards as set by ETL, F.C.C., NEC, I.E.E.E., be listed by UL and carry a five year replacement warranty. Separate ballasts should be provided for each lighting fixture; exception, tandem or cross ballasting of adjacent fixtures is permitted provided the fixtures are directly connected to each other.

.1.7 Ballasts for compact fluorescent lamps shall be electronic type, and shall have the following characteristics:
   A. Ballasts to be high Power Factor type.
   B. Ballasts factor shall be .95 or greater.
   C. Ballasts for multiple lamps shall be parallel wiring type.
   D. Minimum starting temperature shall be 50 Degrees F.
   E. Fixtures with multiple ballasts shall have individual fusing for each ballast.
   F. Total harmonic distortion shall be less than 20%.
   G. Ballast shall contain end of lamp life fault mode shutdown protection

.1.8 LED (Light Emitting Diode) fixtures may be considered for illuminating interior spaces. Provide spare parts for each type LED fixture
   .1.8.1 If dimming of LED fixtures is desired, it will be the responsibility of the A/E to specify the correct dimmers and provide the correct wiring diagrams as part of the contract documents.
   .1.8.2 Workable sample fixtures and dimmers will be provided during the design phase and with the shop drawing submittal for review and comment. These fixtures will become attic stock.

.2 Line Fuses: A line fuse shall be included in the fixture for each ballast in addition to the internal protection of the class "P" ballasts. Line fuses shall be appropriate for the application and wired in place by the fixture's manufacturer. Fusing for fluorescent lighting fixtures shall be non-time delay type similar to Bussmann type GLR with HLR holders.

.3 Lenses shall not be specified as an alternative for louvers. If lenses are required for the project, the project shall be engineered for these units. Tempered lenses shall be specified on quartz lamp fixtures.

.4 Fluorescent Lamps: Four (4) foot 32 watt and two (2) foot, 17 watt, T8, instant start lamps with color temperature of 3500K and minimum of CRI of 74.
.5 Specify the use of exit signs utilizing Light Emitting Diodes (LED) light source with life expectancy greater than (10) ten years.

.6 INCANDESCENT LAMPS: When approved by the University, specify the 130-volt, inside frosted lamp for general application.

.7 LIGHTING SAFETY: Stairwells in buildings shall have sufficient fixtures so that the loss of one lamp or ballast will not leave the area dark. The mounting of the fixtures shall not be at the extreme height but must be accessible for maintenance. Position fixtures only on walls over landings at a minimum height of seven (7) feet to the bottom of the fixtures and a maximum height of eight (8) feet to the top of the fixtures. Fixtures shall have lenses; no bare lamps shall be permitted. Lighting in stairwells shall not be manually switched.

.8 Provide the following spare parts with the listed quantities for compact and/or T5 fluorescent fixtures for each item and size required:

A. Fuses – 10%, minimum of 15 per amp rating
B. Fuse Holders – 10%, minimum of 5 per each type
C. Ballasts – 5%, minimum of 3 of each type
D. Lamp Sockets – 10%, minimum of 10 of each lamp type
E. Fixture Lenses – 10%, minimum of 2 of each lens type

.9 All submittal reviews for Compact and/or T5 Fluorescent fixtures shall include the following:

A. Catalog cut sheets.
B. Lists of spare parts with quantities to be furnished.
C. Samples of fixtures along with a sample of each spare part to be supplied.

Turn spare parts over to the university area shop supervisor and obtain signed receipt. A copy of each approved submittal and a copy of each signed receipt shall be included in the Operation and Maintenance Manuals.

.10 Spare lamps should be provided as follows:

<table>
<thead>
<tr>
<th>Lamp Type</th>
<th>Quantity Installed</th>
<th># of Spares</th>
</tr>
</thead>
<tbody>
<tr>
<td>H.I.D.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21 or more</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fluorescent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1-10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11-20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21-50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>51-200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>201 or more</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Quantity of lamps installed and not fixtures should be calculated for each lamp type and wattage.

.10.1 Determine the number of spare incandescent lamps of each wattage and voltage for the project with University project manager and operations representative.

.11 Incandescent lighting is permitted in dedicated Telephone Equipment Rooms.

.12 Fixture whips shall be made up of either #12 conductors in ½” flexible conduit minimum or #12 type MC Cable minimum.

.1 MC cable shall be provided with green grounding conductor.

.2 If cable ties are used for support then they must be UV stable cable ties.

.3 Fixture whips below ceilings may be provided with as cords similar to type “ST” rated 600 volts provided the following are met.

.3.1 Limit one cord per fixture.

.3.2 Do not daisy chain fixture cords for exposed fixtures.

.3.3 ST cord shall be provided with green grounding conductor

.3.4 Cord shall not be extended above ceiling other than into outlet boxes

.3.5 Cords are made up of #14 conductors minimum

.3.6 Cords longer than six feet are properly supported

.3.7 If cable ties are used for support then they must be UV stable.

.4 SO Type cord may be used exposed below open structures for HID fixtures only if they are provided with an appropriate cord cap.

26 56 00. EXTERIOR LIGHTING

.1 LIGHTING FOR THE ENTIRE SITE, INCLUDING DRIVEWAYS, WALKS, PARKING AREAS, and THE BUILDING PERIMETER shall be included in the contract documents.

.2 FIXTURES: High Intensity Discharge (metal halide) fixtures mounted on the building or on suitable standards are required for all exterior site lighting east of the Olentangy River. Exterior lighting west of the Olentangy River shall be high pressure sodium. These fixtures shall be automatically controlled by photocell(s) for a “dusk on dawn off” operation. More details about exterior lighting or lighting poles may be obtained from OSU Facilities Operations and Development website at https://fod.osu.edu/resources, click on “Design” tab in Vendor Resources.

.2.1 LED fixtures may be considered as a lamp source for exterior lighting. Additionally the project will be required to provide the university with spare parts for light fixtures and poles. Quantity of spare parts will be determined on a project by project basis.

.2.2 Light Control shall be provided on all exterior lighting fixtures. The fixture shall be insect proof. Vandal proof fixtures shall be used if the fixtures are mounted 10 feet or less off the ground.

.3 FIXTURE LOCATION: Fixtures shall be located in such a manner that dark voids and excessive glare in windows are eliminated. Accessibility for servicing must be considered
in locating fixtures. Consideration must also be given to light spillage onto adjacent facilities (existing or planned) such as greenhouses, which are light sensitive. Use directional or shielded lighting as necessary. Check with the University Engineer for the type of lights. Grounding rods shall be installed in all lighting poles.

.4 Outdoor Lighting Levels shall be designed as follows:

.4.1 Primary Walkways and problem areas - 2 foot-candles (FC) average and .5 FC minimum.
.4.2 Secondary Walkways and other areas - 1 FC and .25 FC minimum.
.4.3 Primary Streets - 2 FC average and .25 FC minimum.
.4.4 Parking Lots - 1 FC average and .25 FC minimum.
.4.5 High Activity outdoor parking (i.e. St. John Arena) 2.4 FC average and .6 FC minimum.

.5 Design outdoor lighting to be fed from 100-amp switch, which in turn feeds 100 amp contactor with coil controlled by a photocell. Lighting contactor shall be provided with "hand-off-auto switch. Use twist lock type photo controls to control contactors.

.5.1 Load side of lighting contactor will be provided with a fusible 100 amp disconnect switch to help with serving of lighting.

.6 Run all three phase legs and neutrals to lighting standards and fuse each pole individually. Alternate each pole to different phase legs and balance phases. Conductors used for outdoor lighting shall be full color insulation for the designated voltage.

Commentary: Do not use black conductors with color tape.

.7 Taps inside poles shall be insulated and molded for precise fit. Connectors with removable access plugs over hex screws. These connectors shall not require cover and taping. Connectors shall be abrasion and chemical resistant and also be UV rated. Connectors shall be rated for 600 volts, 90 degrees C.

Commentary: Split bolt connectors are not acceptable.

.8 The University has no secure storage. Any existing poles, luminaires, concrete collars or screw-in bases removed for relocation at a later date must be stored off campus at the project's expense or in the project's staging area. Luminaires shall be removed prior to pole removal and stored indoors. Any items, except for luminaires, being turned over to the University shall go to the University designated storage location. Luminaires shall be taken to the M/E shop at 2560 Kenny Road.

.9 All exterior lighting poles shall be provided with color coded tag as noted on the University website. Tags will identify pole number, power source and circuit number and will be color coded to distinguish phase of power source.

.10 Outdoor lighting shall be fed with full color conductors.

.11 When installing the Gullwing poles, provide Quazite box adjacent to pole and provide #10 wire from feed into pole base. Fusing shall be accessible from pole base.

.12 Any conductors removed for outdoor lighting and not being reused shall be taken to the M/E shop at 2560 Kenny Road.
26 58 00. LIGHTING CONTROL

.1 MULTIPLE SWITCHING: The use of multiple switching shall be evaluated for each space and condition. Where possible, switching shall be circulated to effectively use artificial (natural?) lighting from windows; to permit light reduction during partial occupancy; and to permit reduced lighting for custodial activity.

OCCUPANCY SENSORS shall not be used as the sole means of switching. Manual switches will be provided in all areas with occupancy sensors. Occupancy sensors shall not be used in mechanical rooms. At installation, set all sensors to maximum sensitivity and maximum time delay.

.1.1 Occupancy sensor may be used in single person rest rooms.

.1.2 Multi-compartment restrooms shall be provided with at least one night light.

.2 REMOTE SWITCHING by means of a central control should be evaluated for new construction and for large renovation projects.

.3 DIMMING CONTROL: Where dimming is required it shall be used to control incandescent lighting and may be used for Hi-Lume and approved solid state dimming ballast fluorescent fixtures for low lighting levels. The control panel/panels required for the dimming system shall have the U.L. label. Each dimming module shall be U.L. tested and tested specifically for the type of load it is controlling. Each dimmer module shall possess a means of easily disconnecting power on an individual module-by-module basis.

Dimming panels shall be cooled without the use of cooling fans with no exception, and shall be capable of operating as such in an environment of 0 degree to 40 degree centigrade. Satisfactory independent laboratory test results shall be required, that at +40 degree centigrade and at full load, the maximum temperatures of both filter chokes and SCRs/Triacs are not exceeded.

There shall be one air-gap positive off relay for dimmer, either integral to the dimmer or mounted elsewhere in the same panel. Other advanced technological approaches that give the same or better operational result is highly recommended by this Standard.

All controls shall have the capabilities of reverting back to their previous status after any duration of power outage (power failure memory), without the use of any type of rechargeable or trickle-charge type of battery.

LUTRON DIMMING SYSTEMS with ten years warranty meet University standards. Other systems must be submitted to the University Engineer for approval.

.3.1 SPECIAL REQUIREMENTS FOR FLUORESCENT DIMMING SYSTEMS: Before specifying fluorescent dimming systems, the A/E shall consider the following:

.3.1.1 100 hour "burn-in time is required for the fluorescent lamps when using the dimming ballasts.

.3.1.2 the cost of replacing the ballast and lamps when needed is 200-300% more than replacing Standard Systems.

Therefore, this Standard requires the A/E to review the application of dimming devices and submit recommendations to Facilities Design and Construction before incorporating into specifications.

.4 PARKING RAMP INTERIOR LIGHTING shall be circulated to permit lighting of dark interior areas during the day without lighting those areas which receive sufficient natural light. Automatic control of ramp lighting by photocell is required.
.5 ALL EXTERIOR AREA AND SECURITY LIGHTING shall be “dusk on and dawn off”, powered from one location in the building, and controlled from the photo control, with provisions for manual override. Time clock control shall not be used on exterior or security lighting.

26 60 00 EMERGENCY PHONES

.1 A/E to specify emergency phones as directed by the OSU Project manager and the university Department of Public Safety. (See appendix Y for additional information)

.2 Emergency phones will be provided with power and a communications line from the nearest building. Specify contractor to provide two different conduits (See appendix M for additional information)

.3 Both conduits may be PVC Schedule 40 rated for direct bury underground. Conduits inside the building are to be Galvanized Rigid Steel (GAR).
   .3.1 A/E shall specify Contractor to provide manufacturer’s recommended cement for PVC conduit.

.4 Power for emergency phones shall be 120 volt AC fed from a dedicated 20 amp/1 pole circuit breaker. Provide circuit breaker with lock-on device.
   .4.1 If the building has a generator then A/E shall specify to connect emergency phone to a dedicated emergency circuit breaker.

.5 Emergency phones shall be manufactured by Gai-tronics and made up with the following components:
   .5.1 Stanchion shall be Gai-tronics model 234-030 (Note: this stanchion is OSU Specific)
   .5.2 Emergency Phone shall be Gai-tronics Model 397-001 single button flush mounted.
   .5.3 Strobe light at the top shall be Gai-tronics model 540-001 120 Volts A.C. with LED strobe lamp. Strobe to have a NEMA 3R weatherproof rating, UL listing and an approximate 10 year lamp.

.6 Any existing emergency phones being relocated shall meet the requirements of paragraphs .1, .2, .3 and .4 above.

.7 Mount emergency phones on either a screw-in base or concrete base. See the following website for details:
   .7.1 https://fod.osu.edu/resources , click on “Design” tab in Vendor Resources

.8 Refer to Division 27 Section 273205 and Appendix M for additional information

END OF DIVISION 26 - ELECTRICAL